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AGRICULTURAL MEMORANDUM NO 392

An annotated bibliography on the effects of mulching on plant climate, with some comments on consequent yields.

Part I - Review Articles

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Introduction: The bibliography is being prepared in 8 parts as follows:

I. Review articles
II. Effects on temperatures
III. Effects on soil moisture
IV. Effects on erosion and soil physics
V. Effects on pests and diseases
VI. Effects on growth of plants (including roots)
VII. Effects on yields of plants (quantity and quality)
VIII. Effects on weed suppression

Each part is subdivided by crop into 6 sections:

1. No specific crop
2. Temperate tree fruits
3. Temperate horticulture, soft fruit, vegetables and flowers
4. Forestry
5. Grasses and cereals
6. Tropical and sub-tropical crops

The parts will be issued as they become complete. Part I - Review articles is attached.

Any comments or suggestions on this paper should be sent to the author.

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For part II see: AGRICULTURAL MEMORANDUM No. 423

Part I - Review Articles

1.1 No specific crop

Schaller and Evans (1) in their review of trials on crop residue mulches on the soil state that the beneficial effects consist mainly of improved soil structure and moisture, protection against raindrop impact, decreased soil temperature and increased microbial activity in the soil horizon containing the residues. Jacks et al (3) comprehensively review the effects of mulching on soil properties quoting many references up to 1955 and devote Part 2 of their review to mechanised stubble mulch farming.

The utilization of sawdust in France from the 18th century to the present day is discussed by Lenglen (4), while Staff (5) and the special number of Italian Agriculture (11) review the many uses of plastic films in agriculture including their use as mulches. Bonfiglioli (12) discusses the types of polythene film available in Italy with special reference to nocturnal radiation from the soil, length of life and also application to various crops. The effects of 8 mulching materials of different texture and rates of decomposition upon the soil environment is examined by Tukey & Schoff (9).

1. SCHALLER F W and EVANS D D. 1954. Some effects of mulch tillage. Agric. Engng Mich. 35, 731-34, 736, 27 refs.

2. DULEY F L. 1955. Stubble mulch farming (in the USA and Canada). [Text in English and French]. Sols afr. 3, No.4, 524-33.

3. JACKS G V, BRIND W D and SMITH R. 1955. Mulching: Part 1. The effects of mulching on soil properties. Part 2. Mechanized stubble-mulch farming. Tech. Commun. Bur. Soil Sci., Harpenden No.49, 87 pp, 273 refs.

4. LENGLEN - . 1955. Sawdust as a source of humus. [in French]. C.R. Acad. Agric. France 41 (10), 476-82.

5. STAFF C E. 1956. Plastic films in farm applications. Agric. Engng St. Joseph, Mich. 37: 741-6, 13 refs.

6. MC ALISTER J T. 1957. Mulch farming gains favour in southeast. Agric. Engng Mich. 38, 312-5.

7. WAGGONER P E, MILLER P M and DE ROO H C. 1960. Plastic mulching. Principles and benefits. Conn. agric. Exp. Sta. Bull. 634, 44 pp.

8. HORNING T R and OVESON M M. 1962. Stubble mulching in the Northwest [USA] Agric. Inf. Bull. 253, US Dep. Agric. 28 pp.

9. TUKEY R B and SCHOFF E L. 1963. Influences of different mulching materials upon the soil environment. Proc. Amer. Soc. hort. Sci., 82: 68-76, 20 refs.

10. TIDICK F. 1965. Plastoponics - planting in artificial foam. [in German]. Dtsche Gärtnerbörse, 65: 405-6.

11. - 1965. Special number: Agricultural uses of plastic materials. [in Italian]. Ital. agric. 102 (4/5), 301-448. Many refs.

12. BONFIGLIOLI O. 1967. Soil mulching with plastic films. [in Italian]. Inf. agrar., Verona, 23: 117-8.

1.2 Temperate Tree Fruits

Bos (1) discusses the advantages and disadvantages of materials available for mulching in fruit growing, while Sturm (2) briefly reviews the mulching of apples.

1. BOS J. 1958. Mulching in fruit growing. Stikstof, No.2, 49-59, 3 refs.

2. STURM M. 1964. The effects of mulching on soil and fruit trees. [in German]. Mitt. Klosterneuburg, Ser. B., 14B: 289-91, 5 refs.

1.3 Temperate Horticulture, Soft Fruit, Vegetables and Flowers

The Handbook on mulches (1) consists of a series of articles by American authorities on various aspects of mulching, including the effect on plant diseases, and includes notes on a wide range of mulch materials. Miss Rowe-Dutton (2) shows how the general principles of mulching have been applied to the cultivation of vegetables and discusses the effects of mulching with different materials on the growth, maturity, pests and diseases, and also yield, quality and economic value for a large variety of vegetables.

Lemaitre (7) indicates the advantages of black plastic mulch and includes brief notes on the use of plastic films with different vegetables and small fruits. Germing (4) reviews the use of plastic film in horticulture in Holland, and Chiusoli (6), Stalagmiti (11) and Tesi (15) discuss the uses of plastic film in Italy. Bry (10) surveys production in France and the mulching of early vegetables and strawberries with black, clear and smoke grey plastic films.

Sheldrake (12) tabulates yield increases with musk melons in his outline of the benefits of plastic mulching and gives advice on preparation and laying the mulch. Siegal (13) uses experiments on cotton, water-melons and vegetables to indicate the benefits of a petroleum mulch.

Sondern (14) describes the relative merits of polythene and PVC as mulching materials and considers the effects of black, white, grey and clear film on soil moisture and temperature and lists different crops which respond best to each colour. In a later paper (16) he gives brief details of investigations in Holland on the light reflective properties of white PVC film and aluminium foil when used as mulches for crops grown under glass.

1. BROOKLYN BOTANIC GARDENS. 1957. Handbook on mulches. Brooklyn bot. Gdn Rec., 13 (1): 1-79.

2. ROWE-DUTTON P. 1957. The mulching of vegetables. Tech. Commun. Bur. Hort. Plant. Crops, East Malling, 24, 169 pp. 345 refs.

3. YEATES J S. 1957. Weed control in horticulture. N.Z. Plants and Gdns, 2: 141-4, 191-5.

4. GERMING G H. 1958. Plastic film in horticulture. [in Dutch]. Meded. Dir. Tuinb., 21: 254-65, 16 refs.

5. THIELE K. 1961. Green manuring and mulching in vine growing. [in German]. Dtsch. Gartenb., 8: 505-7, 6 refs.

6. CHIUSOLI A. 1962. Mulching strawberries with plastic sheeting. [in Italian]. Inf. agrar., Verona, No.52, 6 pp, 25 refs.

7. LEMAITRE R. 1962. Black plastic film as a soil cover in horticulture. [in French]. Bull. hort., Liège, 17: 137-41.

8. WALLS I G. 1965. Polythene mulching of strawberries. Scot. Agric., 44: 199-200.

9. MARSHALL H. 1965-66. Black polythene helps strawberries. Vict. Hort. Dig., 9(4): 4-6.

10. BRY A. 1966. Present trends in France in the use of plastic materials for forcing and mulching. [in French]. Atti II° Congr. int. Appl. Mat. plast. Agric., Pisa, 119-26, 3 refs.

11. STALAGMITI R. 1966. Polyvinyl chloride in market gardening. [in Italian]. Inf. Ortoflorofruttic, 7: 343-6.

12. SHELDRAKE R, Jr. 1967. Plastic mulches. Cornell Ext. Bull. N.Y. St. Coll. Agric. 1180, 8 pp.

13. SIEGEL J R, DAVIDSON J R and KAESTNER A M. 1967. Encap: petroleum agricultural mulch. Prepr. am. chem. Soc. Div. Petrol. Chem. 12, E-59-E-66.

14. SONDERN J A. 1967. Plastic film as mulching material. [in Dutch]. Meded. Dir. Tuinb., 30: 399-405, 7 refs.

15. TESI R. 1967. The use of plastic materials in market gardening. [in Italian]. Frutticoltura, 29: 441-3.

16. SONDERN J A. 1968. An interesting prospect for white light reflective foil as a soil covering. [in Dutch]. Groent. en Fruit, 23: 1539.

1.4 Forestry

Němec (1) discusses rates and techniques of application of rock dusts (quarry wastes) to improve poor forest soils. Gessel (2) examines the deficiency of essential organic material in Washington State soils and discusses the relationships between mulches, composts, fertilizers and various types of soil, defining their functions in order to differentiate their separate uses. Solbraa (3) reviews literature on bark composition and its use as a mulch.

1. NĚMEC A. 1953. Guide to the improvement of degraded forest soils: hints on the use of basic igneous rock dusts for the improvement of stunted plantations and natural stands on degraded and impoverished forest soils. [in Czech.]. Lesn. Knihovna (malá Řada) No.28, 31 pp. 19 refs.

2. GESSEL S P. 1959. Composts and mulches from wood waste. Circ. Inst. For. Prod., Wash. No.33, 14 pp.

3. SOLBRAA K. 1967. Fresh and composted bark as a soil conditioner, and the composting of bark. [in Norwegian]. Medd. Norske Skogforsøksv. 23 No.85, 297-380, 3 pp. of refs.

1.5 Grasses and Cereals

Cruz (1) discusses the practice and benefits of stubble mulching in the Philippines and tabulates experimental results of maize yields obtained in mulched plots given different fertilizer and cultivation treatments. Melsted (2) compares old and new practices using modern implements and stubble mulching and reviews recent work. Schaller & Evans (3) quote recent trials on the effects of crop residue mulches on the soil and state that maize stands are frequently depressed under mulch tillage compared with ploughing. Zingg and Whitfield (4) indicate that in the drier regions of the Western USA the practice of leaving crop residues on the soil surface usually gives slightly increased yields of wheat while in more humid regions the regulation of available soil nitrogen and suitable cropping sequences are essential if yield decreases are to be avoided with mulching.

1. CRUZ S R. 1954. Mulch farming: the latest significant advance in agriculture. Araneta J. Agric. 1, No.3, 1-22.

2. MELSTED S W. 1954. New concepts of management of corn belt soils. Advanc. Agron. 6, 121-42.

3. SCHALLER F W and EVANS D D. 1954. Some effects of mulch tillage. Agric. Engng Mich. 35, 731-4, 736, 27 refs.

4. ZINGG A W and WHITFIELD C J. 1957. A summary of research experience with stubble-mulch farming in the Western States. Tech. Bull. 1166, US Dep. Agric. 56 pp., 31 refs.

1.6 Tropical and Sub-tropical Crops

Bull (3) reviews the effects of mulching on the structure, temperature, moisture and composition of the soil and also on the leaf composition of the crop. Rao (5) considers that plastic sheet mulching is not suitable for Indian conditions and discusses the numerous types of mulches available to coffee growers in India. However, Pattabhiraman (6) found that black polythene mulching in the field was "good but uneconomic" in India. Chalker (7) outlines the virtues of mulching avocadoes and includes brief notes on plastic, hessian, paper, straw, sawdust and wood shavings.

1. HAVORD G. 1954. Mulching for cacao. [Proc.] V Reunión Com. téc. interamer, Cacao, Vol.1, 12 pp., 6 refs.

2. GEORGE C M. 1962. Mulching as a cultural practice in rubber cultivation. Rubb. Bd. Bull., 6: 69-73, 4 refs.

3. BULL R A. 1963. Effects of mulching and irrigation in some East African coffee soils. Turrialba, 13: 22-7, 21 refs.

4. CAHOON G A and OTHERS. 1963. The use of plastic ground covers in citrus nurseries. Proc. Amer. Soc. hort. Sci. 83: 309-15, 8 refs.

5. RAO H H. 1964. Mulching in coffee. Indian Coffee, 28: 180-2, 8 refs.

6. PATTABHIRAMAN T V. 1965. Plastic in coffee plantations. Indian Coffee, 29: 31-3.

7. CHALKER F C. 1966. Mulching of avocadoes. Agric. Gaz. NSW., 77: 231-3.